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Breakdown of the Impulse Approximation for Compton K-Shell Doubly Differential Cross Sections for Heavy Atoms L.A. LAJOHN, R.H. PRATT, University of Pittsburgh — The impulse approximation is known to be valid in the prediction of inelastic photon scattering (Compton) differential cross sections when the photon momentum transfer $|\mathbf{K}| = |\mathbf{K_i} - \mathbf{K_f}|$ is much larger than the average electron momentum p_{av} ($|\mathbf{K}| >> p_{av}$). It was found that this requirement can be relaxed to $\mathbf{p_{av}}/|\mathbf{K}| < 1$ for light atom doubly differential cross sections (DDCS) (P. Eisenberger and P. M. Platzman, PRA **2**, 415 1970). Compton K-shell DDCS for light atoms such as Copper obtained from impulse approximation (IA) (either relativistic or nonrelativistic versions), are in good agreement with exact (within the independent particle approximation) S-matrix (SM) values. For example, the relative difference (Δ) between SM and the relativistic version of IA (RIA), when $P_{av}/|\mathbf{K}| = 0.6$, at the Compton peak in the case of back angle scattering, is about 2% for Cu (Z=29). However it increases to 14% for Sm (Z=62) and 25% for U (Z=92). This rapid increase in Δ with increasing Z can be explained in terms of the sum rule that is used to justify the expression for calculating DDCS in the IA and RIA theory. This sum rule becomes progressively less valid for RIA with increasing Z.

Larry LaJohn
University of Pittsburgh

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